Study on Holon Environment Model in Battle Deduction Simulation System

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Abstract. The battle deduction simulation system is usually designed as MAS (Multi-Agent System). Environment modeling is considered as the most important process in constructing a MAS. The MRM (Multi-Resolution Modeling) technique is used to build the simulation entity models. In order to construct environment model with multi-resolution in the battle deduction simulation system, a classification of battlefield environment is proposed and a battlefield environment modeling method based on the concept of Holon is put forward. This method uses the cooperation of Holon to make environment model form a dynamic hierarchical structure, which has the characteristics of multi-resolution. This environment model is able to offer environmental information with corresponding resolution for the multi-resolution entity model in the battle deduction simulation system.

Keywords: Holon, battlefield environment, battle deduction, simulation, multi-resolution.

1 Introduction

The battle deduction simulation is a battle hierarchy of the war simulation. It’s a typical complex system with large numbers of intelligent entities. These entities form a complex hierarchy by the countermeasure and cooperation among them or by the external command. And these entities advance the simulation system by the interaction among them [1]. According to the characteristic of the battle deduction simulation system, the system is designed as MAS (Multi-Agent System). It’s favorable for the study of the characteristics of the complex system, such as intelligence, nonlinear and emergence. When constructing MAS, the environment, as a independent factor, has the function of providing the space for Agents, communicating with Agents and offer reference for the behavior of Agents. Thus the environment becomes a first-order abstraction in MAS [2]. At present, most research considered environment as a holistic structure. And this point of view restricted the interaction efficiency between Agent and environment. Sebastian Rodriguez considered the environment as a entity with network structure, posed a topology-based Holon environment model to solve the problem of

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constructing a large scale environment model [3]. This model is suitable for the environment that has network topology, such as roads and traffic, whereas most environments in battle deduction haven’t the network characteristic. And for there are lots of entities executing and interacting during the deduction, the MRM (Multi-Resolution Modeling) technique is used to ensure that entities distributed in different hierarchy could execute efficiently and interact correctly. By using MRM technique, the interactions between entities and environment may change alone with different resolution. To provide the proper environment information and interact with entities, the environment model must be flexible. To build the large scale and multi-layer environment model in the battle deduction simulation system, consequently posed a Holon-based dynamic hierarchical environment modeling technique.

2 Holon

What is Holon? The word was coined by Arthur Koestler in his book *The Ghost in the Machine*. It means whole-part literally. Holon describes a phenomenon that an independent entity, which contains several parts, is a part of another entity. Whole means an entity is independent and has certain functions. It can cooperate with other wholes. Part means an entity is part of a whole. Each part has certain functions, and the cooperation of parts form the function of whole. According to all the above, Holon is a recursive concept. One Holon contains several Holons, meanwhile, this Holon is a part of some other Holon.

In the familiar biology, a organism is formed by some entities with certain functions and objectives. For instance, cell always acts according to its own rules. Many independent cells form an organ which acts according to its own rules, and different organs form an organism finally. See from this example, cells and organs both have autonomy and cooperatives. They belong to the different hierarchies of a organism. Organ is a cellulous whole, meanwhile, is a part of an organism. This entity in hierarchy, which has the concept of whole and part synchronously, is a typical Holon.

From analysis above, the two basic characteristics of Holon are autonomy and cooperative. One Holon tends to be a part of another Holon while it keeps its own independent characteristics. This tendency masks a holarchy with specific object have a dynamic hierarchy. The layer of this hierarchy is changed by observer’s viewpoint. The layer of a Holon will keep changing between whole and part till the observer’s viewpoint doesn’t change anymore. By this dynamic hierarchy, holarchy shows a relative independence on different granularity levels. But see from the whole viewpoint, the characteristics of one granularity provide service for the higher level.

3 Holonic Environment Model in Battle Deduction Simulation System

The analysis of the modeling object is required before building the Holon environment model of the battle deduction simulation system. In the battle deduction